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ON OVIPOSITION AND NURSING IN THE BATRACHIAN GENUS DENDROBATES.

BY HERBERT H. SMITH.

IN 1875, while at Santarem, on the Lower Amazon, my attention was called to a brown frog which was very common in the damp forests of the highland, hopping about under the trees. I frequently saw it several miles from any stream or pool. The hunters told me that this frog carried its young on its back. I offered a high price to any one who would bring me a specimen with its young, but no one took advantage of my offer; and though I was collecting every day in the woods where the frog was so common, I never saw the young at all. I finally concluded that my informants had confounded this species with the Surinam toad, which is probably found at Santarem, though I never saw it there; so I dismissed the subject from my mind. My specimens of the frog were lost, with other batrachians and reptiles, on the voyage to New York, but I hope to determine the species with fresh examples at some future time.

One day in October or November, 1884, I was camping in a lonely spot forty miles northeast of Cuyabá, in Western Brazil; the place was on the *chapadão*, or table-land, close to a deep, rocky ravine. All around were little tracts of damp meadow, such as are frequently seen even on the higher portions of the *chapadão*. Brazilians call such spots *varzeas*, a name also applied to the grass-lands on river-plains, to which these patches have only a superficial resemblance. The *varzeas* of the highland

always lie above a layer of hard rock, on which water accumulates in the rainy season, soaking the thin layer of loam and turf which covers it. At such times there may be half a dozen little streams flowing through a spot of *varzea* over smooth rocks, where the subsoil has been washed away; but in the long dry season, from May to October, the water evaporates, the ground dries up and cracks, the grass on it withers, and generally the streams disappear. The plants and animals of the *varzeas* are different from those of the rest of the table-land, the species being adapted to endure these periodical changes. The place that I am speaking of is quite dry during four or five months of every year, and even the ravine at its side has no water; at that time the nearest stream is several miles away.

Wandering over the meadow, now sodden with a recent rain, I observed a small frog of a kind which I had frequently seen on the *varzeas*. Some peculiarity in its appearance made me examine it more attentively, when, to my astonishment, I saw that its back was covered with little black bodies, set close together like paving-stones on a street, if I may compare small with large; the entire upper surface of the frog, except the head, was concealed by them. I very quickly saw that these were tadpoles, so crowded in the small space that the tails and part of the bodies were hidden. They were moist and glistening, as if they had just been taken from water, though the sun was shining hotly over them. If my observation was correct, they were kept in place by a viscid secretion, either from their own bodies or from that of the parent. They moved slightly while I was watching them.

Up to this time the frog, with its little colony, had remained quite still, so that I had a good opportunity to examine it; but when I attempted to secure it, it hopped into a patch of grass, where, despite of all my searching, I could not find it. I judge that it entered some hole among the grass-roots. Heartily appreciating the fact that a frog in the hand is worth two in the bush, I was obliged to content myself with an entry in my note-book of what I had seen and a resolve to observe the species more carefully in future.

I frequently saw the frog after this, but could never get it with its young. Nearly a year after, my assistant, Mr. W. C. Smith, found a specimen with its colony of tadpoles on a *varzea* very

similar to that I have described and in the same region; this he secured, and it is now in the possession of Professor E. D. Cope. Mr. Smith writes me: "Four of the young, I believe, dropped off and were lost; being in a hurry, I threw the frog at once into a bottle of alcohol, and I did not observe how the young were attached to the back."

These very imperfect observations are all that I can give concerning the habits of this very singular batrachian, but I hope that they may serve to direct the attention of other naturalists to these species. The Santarem frog mentioned above was similar in form to this one, though a good deal larger, and very likely it belongs to the same genus. In view of my observations on the *chapadão* species it seems probable that the information given by the hunters was correct, and that the Amazonian frog also carries its young on its back.

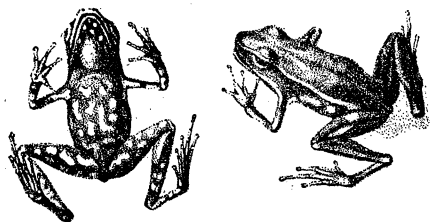
In both cases there seems to be an evident adaptation of the habits to the surroundings. The Santarem forests are always moist and comparatively cool, but the absence of standing or running water in those parts where the frog is seen would prevent the ordinary disposition of its young. The *varzeas*, on the contrary, are wet and even partly flooded after rains; but even in the height of the rainy season the pools and streams may dry up if a few days pass without showers. If the young frogs were left in the water they would run the risk of being destroyed before their development was completed. In the dry season the frog, like most other animals, disappears from the *varzeas*; probably it retires to some crevice where it can remain sheltered until the rains set in again. Both the frogs observed with young were seen at the beginning of the rainy season.

It would be interesting to know how the young (or eggs) are first placed on the back of the parent and how they are nourished.

I may notice here that the bright spots on the legs of this frog and of other species serve in a very curious way to conceal the animals. They are only visible when the frog is hopping, and their sudden disappearance when the animal comes to rest causes one to lose sight of it altogether; for the eye naturally follows the bright colors, and perhaps they have the effect of momentarily dazzling it, so that the sombre general surface of the frog, very like the ground on which it sits, becomes for an instant

invisible, just as a small dark object becomes almost invisible immediately after gazing at a scarlet cloth or a candle. I have noticed similar effects produced by color-spots in certain insects, especially the butterflies, which are often vividly colored on the inner surface of the wings, so that they are extremely conspicuous when flying; but as soon as the insect comes to rest these colors disappear, and the plain outer surface of the wings is, by contrast, momentarily invisible.

NOTE BY E. D. COPE.—Examination of the specimens collected by Mr. Smith shows that they belong to a species of the



Dendrobates braccatus Fitzinger. Views from side and below. Copied from Steindachner. (None of my specimens have so much black below.—E. D. C.)

genus *Dendrobates*, which I have described under the name of *Dendrobates braccatus*.¹ It agrees in most of its characters with *D. trivittatus* Spix., but is very much smaller, not measuring half its linear dimensions. As the specimens are, according to Mr. Smith, adult, they must be regarded as specifi-

cally distinct. It is also related to the *D. hahneli* of Boulenger,² but differs in the considerably shorter posterior limbs.

The singular manner in which this species carries its larvæ constitutes a method of nursing distinct from any of those enumerated by Mr. Boulenger in his table in the *Annals and Magazine of Natural History* for 1886, of which I give a copy, inserting the *Dendrobates*:

- I. The ovum is small and the larva leaves it in a comparatively early embryonic condition.
 - A. The ova are laid in the water.
Probably the majority of Batrachians; all European forms except Alytes.
 - B. The ova are deposited out of the water.
 - a. In holes on the banks of pools, which become filled with water after heavy rain, thus liberating the larvæ.

Leptodactylus ocellatus, L.; *L. mystacinus* Burm.; *Paludicola gracilis* Blgr.

- b. On leaves above the water, the larvæ dropping down when leaving the egg.

Chiromantis rufescens Gthr.; *Phyllomedusa jheringii* Blgr.

- II. The yolk-sac is very large, and the young undergoes the whole or part of the metamorphosis within the egg; at any rate the larva does not assume an independent existence until after the loss of the external gills.

¹ Proceedings Amer. Philosoph. Soc., 1887, April.

² Proceed. Zool. Soc. London, 1883, p. 636, Pl. LVII., Fig. 4.

- A. The ova are deposited in damp situations or on leaves, and the embryo leaves the egg in the perfect air-breathing form.
Rana opisthodon Blgr.; *Hylodes martinicensis* D. & B.
- B. The ova are carried on the parent.
- a. By the male.
- a. Round the legs; the young leaves the egg in the tadpole state.
- Alytes*.
- β. In a gular (the vocal) sac; the young is expelled in the perfect state.
- Rhinoderma*.
- b. By the female.
- a. Attached to the belly.
- Rhacophorus reticulatus* Gthr.
- β. Attached to the back;
- aa. The young completes its metamorphosis within the egg.
- Pipa*.
- bb. The free tadpole is carried on the parent.
- Dendrobates*.
- γ. In a dorsal pouch.
- aa. The young leaves the pouch in the tadpole state.
- Nototrema marsupiatum* D. & B.
- bb. The young leaves the pouch in the perfect state.
- Nototrema testudineum* Esp.; *Opisthodelphys ovifera* Weinl.

It approaches nearest to the habit of the *Pipa monstrosa*, which also carries the young on the back. But, as is well known, the skin itself and not a gelatinous secretion encloses the eggs in that species and retains the young until the metamorphosis is complete. The *Dendrobates*, however, furnishes a hint as to the origin of the temporary growth in *Pipa*.

Several larvæ accompany one of the specimens of this species, which are stated by Mr. Smith to have been adhering to its back when it was taken. They do not resemble those of *Pipa*, but rather those of *Rana* or *Bufo*. The branchial opening is on the left side, and no limbs are developed. The tail is long. The mouth is not peculiar. The decurved lower lip is present, and is furnished with two transverse series of bristle teeth. A single series of the same extends entirely across the superior labial region, above the upper horny jaw. The papillæ are rather long, and extend all round the inferior lip, and for a short distance on each side at the lateral end of the upper lip, the series presenting an entering angle opposite the mouth. This species is described and figured² by Steindachner in the *Verhandl. der k. k. zoölog. botan. Ges. in Vienna*, 1864, p. 258, who refers it to the *D. trivittatus* ("nigerrimus"), under the impression that the specimens before him are not adult. He states the latter were labelled *Dendrobates braccatus* by Dr. Fitzinger. This name is not adopted by Steindachner.

² Plate XIII., Fig. 2.